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| **Exploring Rules in Depth**  \*Lesson is adapted from activities in *ThinkMath!,* Harcourt School Publishers, 2008. |
| **Mathematics, Grade 1** |
| **Materials:** |
| **TEKS/SEs:**   * 1.4 – identify, describe, and extend concrete and pictorial patterns in order to make predictions and solve problems. * 1.5B – find patterns in numbers, including odd and even * 1.5C – compare and order whole numbers using place value * 1.5D – use patterns to develop strategies to solve basic addition and basic subtraction problems   **Objective 6 TEKS/SEs (Underlying Processes and Mathematical Tools):**   * 1.11A – identify the mathematics in everyday situations * 1.11B – solve problems that incorporate understanding the problem, making a plan, carrying out the plan, and evaluating the solution for reasonableness * 1.11C – select or develop an appropriate problem-solving plan or strategy including drawing a picture, looking for a pattern, systematic guessing and checking, or acting it out in other to solve a problem * 1.11D – use tools such as real objects, manipulatives, and technology to solve problems * 1.12A – explain and record observations using objects, words, pictures, numbers, and technology * 1.12B – relate informal language to mathematical language and symbols * 1.13 – use logical reasoning; justify thinking using objects, words, pictures, numbers, and technology |
| **Lesson objective(s):**   * + Students will :     - Explore identifying and putting together rules that undo each other     - Explore working with rule machines that require two inputs |
| **Differentiation strategies to meet diverse learner needs:**   * Problem- solving, inquiry-approach * Hands-on exploration * Collaboration and discussion |
| **ENGAGEMENT**   * Play quick game of Guess My Rule with the class - where the rule is that the output is the same number as the input. Ask for volunteers to guess the rule. |
| **EXPLORATION**  **Part 1**:   * Once the class has guessed the rule from Engagement, display a picture of two rule machines linked together.   + *You put something into the first machine. Its output is the input for the second machine. Then the second machine produces the final output for the connected machines.*   + *The two machines have the same effect as the no-change rule you used during the game.*   + *Ask: If the rule for the first machine is add 4, what rule can the second machine use to undo the first machine?* * Give each student a picture of a rule machine with a rule labeled on it. Have students find someone in the class whose rule machine connects to theirs to make a no-change machine. * Ask pairs to share the results of making their no-change machines. Encourage them to demonstrate how their machines work.   + *How did you find your no-change partner*?   + *Can you and your partner pair up with another group of partners to achieve another no*-*change rule?*   **Part 2**:   * Let students explore further with undoing input-output rules. Ask students to find the rule for the following table:  |  |  |  |  |  | | --- | --- | --- | --- | --- | | In | 20 | 15 | 40 |  | | Out | 30 | 25 |  | 43 |  * + *Describe the rule.* The rule is Add 10. * Ask students to find the rule for the following table:  |  |  |  |  |  | | --- | --- | --- | --- | --- | | In | 67 | 40 | 25 |  | | Out | 57 | 30 |  | 70 |  * + *Describe the rule.* The rule is Subtract 10.   + *What do you notice about the rules for the two tables?* The rules undo each other. * Give students more examples similar to this one. Allow them to come up with their own examples.   **SUGGESTIONS**   * *What two different rules could you use together to get the same input and output for a no-change rule machine?* |
| **EXPLANATION**   * Students will explain their thinking and justify their solutions in groups and in whole-class discussion, as well as with drawings, diagrams, and oral explanations. |
| **ELABORATION**   * Draw and label a rule machine that requires two inputs: * *If I put 2 and 4 in the machine, what rule can the machine use to give me an output of 6?* The rule is add the two inputs together. * *If I put 5 and 5 in the machine and use the same rule, what number will the output be?* The output will be 10. * This activity can be done with multiple styles of input and different rules:   + Input: # of pennies and dimes   + Rule: compare and select largest number   + Rule: difference between 2 numbers |
| **EVALUATION**   * + Ask: Your brother does not understand input-output tables. How would you explain to your brother how you can find the rule for an input-output table? |